Research FOR FARMERS

WINTER—1962

CANADA DEPARTMENT OF AGRICULTURE

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HON. ALVIN HAMILTON, *Minister*
S. C. BARRY, *Deputy Minister*

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NOTES AND COMMENTS

Department scientists are evaluating a new test for determining the sanitation status of poultry hatcheries. In his article, "Microbial Examination of Poultry Hatcher Fluff", Dr. S. E. Magwood states that poultry hatcheries bring forth the greatest number of "live births" of any branch of the animal industry—but in the process they may encounter problems with diseases that can be spread in their hatching machines. For example, an egg harboring a specific bacterial infection such as pullorum or paratyphoid disease may, because of the simultaneous exposure of hundreds or thousands of susceptible birds, quickly infect the entire hatch. Dr. Magwood cites other examples. And, as he points out, when these infectious agents get into the machine, they persist unless sanitation measures are adequate. Of course, most hatchery operators routinely fumigate their hatchers and setters, with formaldehyde gas being the most commonly used agent. But, writes Dr. Magwood, the variations in the quantities of formalin that have been recommended for the purpose by various workers and incubator manufacturers have prompted investigations of the amount required for effective fumigation. Because many factors such as temperature, humidity and air-tightness of the machine influence the efficacy of fumigation, a need was evident for a test by which results of the fumigation and sanitary measures could be evaluated. It is such a test that Dr. Magwood discusses, beginning on page 8.

* * *

The new science of exocrinology, we have been informed by Dr. S. S. Munro, geneticist with the Livestock Division, promises to bring new knowledge of animal behavior and reproduction. It deals with the regulation of physiological processes by external secretions, differing from endocrinology which is concerned with secretions from hormones within the body. Research on mice in Europe has shown that exposure of newly bred females to the odor of strange males will very often block pregnancy. Different strains and breeds have different odors which may affect the degree of pregnancy block. Scent glands apparently incite nerve receptors which alter reproductive processes in this species. Dr. Munro points out that if reproduction of domestic animals is similarly influenced, exocrinology could be a matter of great interest to researchers in this country.

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Contributions should be addressed to the Secretary, Editorial Board, Information Division, Canada Department of Agriculture, Ottawa.

Cover Photo: **Newly hatched chicks may not show signs of hatchery-disseminated diseases but fluff from them can be examined microbiologically for evidence of unsanitary hatchery conditions. (see article, p. 8-9.)**

Grasshopper feeding.

Grasshoppers and Weather

Search Intensified to Get More Accurate Forecast of Grasshopper Damage Potential

D. S. Smith

WHY is it that in some years grasshoppers are scarce and in other centres across the country many years of research a complete answer is still not available. But through work conducted at the Lethbridge Research Station and other centers across the country we are getting some of the information necessary to complete the over-all picture.

Weather is undoubtedly one of the major controlling influences. It is a common observation that drought and grasshoppers go together, whereas in wet years with late springs there are very few grasshoppers. One way of studying what weather does is to isolate one factor, such as temperature, and study its effects alone, holding other factors constant. Much work of this type has been carried on. It shows, for instance, that grasshoppers become active only when the temperature reaches about 60°F. and that they will feed between this temperature and about 80°F. At higher temperatures they start seeking shade. Tests at different humidities show a definite preference for drier air. Many such observations taken together will provide a picture of the grasshoppers' reaction to their environment. They obviously like dry and warm weather, thus the large numbers in such years. Hence also the fact that they are not found in heavy vegetation where they would be shaded from the sun and exposed to a higher humidity, but rather in a 'mosaic' type of vegetation—clumps of vegetation separated by bare ground.

So we can go on building up the picture, refining our methods of study to fill in the shadowy and crude outline we started with. We have to consider the effect of temperature on hatching, on the development of the grasshopper, on the number of eggs laid, on the food the grasshopper eats, and so on. For instance, we have found that when the temperature is warm enough in the spring to allow an early hatch more nymphs

Dr. Smith is a specialist in grasshopper ecology at the CDA Research Station, Lethbridge, Alta.

survive than from a late hatch. This condition exists in drought years and so we have another reason for high populations in these years. Other factors such as light may be important. Some plants grown in a greenhouse in winter do not support the grasshopper as well as similar plants grown in the greenhouse in summer. There is obviously a long and complex effort needed to fit all the facts together to understand, from the inside as it were, how weather affects grasshoppers.

Another method of study has become possible recently with the accumulation of many years of data on the size of grasshopper populations. These data come from the annual grasshopper surveys in which the estimated number of grasshoppers per square yard is recorded for hundreds of individual sites in each province. The surveys were started during the 1930's and now we have enough data to apply statistical analysis to them. The basic idea is to compare the size of the population in each year with each of various weather factors (average monthly temperature, minimum temperature, amount of rainfall, for example) and see whether variations in one correspond with variations in the other; in other words, to find a correlation between them.

Electronic Computer Used to Compare Data

Various groups are working on the survey data. At the Lethbridge Research Station, we are making use of an electronic digital computer to compare the population data with any number of weather factors of the current or preceding years. Thousands of correlation co-efficients can be thus obtained and the problem then becomes one of deciding which of these are meaningful. Suggestive results are already being obtained indicating the possible effects of temperature and rainfall of certain months in years preceding the high populations.

One useful result of this will be that we can pin-point areas within which weather conditions are favorable for build-up of grasshoppers. Of course, grasshoppers have to be present in the areas for this to occur, but by indicating areas that should be watched or areas that do not need to be watched a more accurate forecast of grasshopper damage potential will be made with more economy of time than at present.

Grasshopper damage.

Left: **Forage yields of alfalfa decreased by 82 per cent when the soil was submerged for 10 days, and by 45 and 31 per cent respectively when the water table was maintained at 10 and 16 inches below the soil surface during 10 days.** ***Right:*** **Forage yields of reed canary grass increased by 13, 21 and 30 per cent when the soil was submerged for periods of 10, 20 and 30 days respectively.**

Does Flooding Affect Crop Production?

Experiments Reveal Grasses More Tolerant to Flooding than Legumes

S. J. Bourget

THE effects of flooding may be of considerable economic importance for hay and pasture mixtures during all stages of growth, particularly on lands which are flooded in the spring or during the growing season. Accordingly, if a farmer has a field which is poorly drained and, either because of cost or of lack of facilities, it is impossible to establish a drainage system, he may wish to use the field as a permanent pasture. In such a case, it would be important to seed plant species which can withstand high levels of soil moisture. We know that certain plant species can withstand flooding conditions better than others, but we still have to establish to what extent crop yields are affected by periods of flooding. Under soil flooding conditions, plant roots may not get proper aeration, anaerobic reactions predominate and sometimes toxic soil constituents are formed. Plant species differ in their response to a soil atmosphere of low-oxygen content. Little information is presently available on the resistance of different plant species to flooding.

Dr. Bourget is a specialist in soil physics with the Soil Research Institute, Research Branch, Ottawa, Ont.

In greenhouse experiments at the Soil Research Institute, Ottawa, we evaluated the effects of different degrees of flooding, for three periods of different lengths, on three grass species and three legume species. Flooding treatments were applied to well-established stands of timothy, brome grass, reed canary grass, alfalfa, bird's-foot trefoil and Ladino clover. The flooding treatments were equivalent to field conditions with a water table at the soil surface, at 10 and 16 inches below the soil surface. They were maintained for periods of 10, 20 and 30 days. The results were compared with those from a check treatment which consisted of normal watering under greenhouse conditions.

We found the grasses to be more tolerant than the legumes to flooding. In fact, brome grass and reed canary grass benefited from flooding. The top yields of brome grass increased by 40, 59 and 67 per cent when the water table was maintained at the soil surface for 10, 20 and 30 days respectively. The corresponding top yields of reed canary grass increased by 13, 21 and 30 per cent. The top yield of timothy remained fairly constant under similar flooding treatment. When the water table was maintained at 10 and 16 inches below the soil surface, the top yields of grasses were usually lower than those obtained with a water table at the soil surface. The root weights of the three grasses were not affected markedly by flooding, although they tended to decrease slightly as the water

Determining rate of oxygen diffusion in the soil.

table was lowered from the surface to 10 and 16 inches below the surface.

The legumes were much less tolerant to flooding than the grasses. The top yields of alfalfa decreased by 82 per cent when the soil was submerged for 10 days. Complete flooding for periods of more than 10 days killed the alfalfa plants. Ladino clover top yields decreased by 24, 30 and 37 per cent when the water table was maintained at the soil surface for 10, 20 and 30 days. However, the top yields of bird's-foot trefoil increased by 23 per cent when the soil was completely flooded for 10 days and decreased by 18 and 15 per cent when the flooding treatment was maintained for 20 and 30 days respectively. The top yields of all three legumes, when the water table was dropped to 10 and 16 inches below the soil surface, usually increased over those obtained with a water table at the soil surface. The root yields of the legumes followed a pattern similar to that of the top yields.

Because the soil temperature was found to vary from 67° to 81°F. during flooding in the greenhouse, we tried to determine the effect of soil temperature during flooding. Under greenhouse conditions, at temperatures of 41°, 54°, 67° and 80°F., using alfalfa, Ladino clover, bird's-foot trefoil and brome grass, we found that all four plant species were more tolerant to flooding at 41° than at 80°F.

Oxygen diffusion measurements indicated that the oxygen availability at depths of 2 and 5 inches in the soil increased as the water table was lowered. In general, the yields of legumes tended to increase with increasing availability of oxygen whereas the yields of grasses tended to decrease.

Based on this work, it appears that brome grass and reed canary grass can tolerate flooding very well even for periods of 30 days. Bird's-foot trefoil was the most tolerant of the legumes. Alfalfa and Ladino clover definitely require a well-drained soil for proper growth. The effect of flooding may be more moderate in the field because the soil temperature is usually lower than under greenhouse conditions.

Sweet pickles made from equal amounts of cucumber. Note homogenous color and absence of shrivelling in vacuum-treated product (right). *Inset:* Author demonstrating laboratory apparatus used for vacuum treatment of cucumber slices.

Cucumber Pickles

Vacuum Method for Preparation Shows Promise in Morden Tests

R. B. Hyde

A VACUUM METHOD for preparing cucumber pickles has shown promise in laboratory tests at Morden. It could supplant the age-old fermentation process for pickles and improve the newer pasteurization process that has gained in commercial usage during recent years.

Most cucumber pickles are still produced by the fermentation method. This process is carried out in large wooden vats holding several tons of cucumbers in salt brine. Soluble sugars are removed from the cucumbers by osmosis and converted by bacteria into lactic acid. This creates a medium in which the cucumbers can cure. When curing is complete, the flesh loses its white opaqueness and takes on an olive-green translucence. The tissue becomes saturated and thus more permeable to the absorption of soluble pickling materials. If the fermented cucumbers are to be stored for several months, the salt concentration of the brine is increased to inhibit further bacterial growth. To make cured cucumbers into pickles, the salt must first be removed by leaching after which vinegar and spices are added. For sweet pickles, sugar is incorporated gradually for several days to minimize shrivelling. The equalized pickles are packed into suitable containers and covered with their own pickling liquid. Heat is seldom applied to

Concluded on page 11

The author is a specialist in Food Technology at the Experimental Farm, Morden, Man.

Above: Apple maggot trap suspended in tree. *Insets:* Close-up of maggot. *Right:* Author studying feeding behavior of apple maggots.

New Approach . . .

Apple Maggot Control

Poison Bait Sprays Studied

W. T. A. Neilson

ONCE AGAIN the apple maggot is the major insect pest of apples in New Brunswick. It is present in almost every orchard and has caused substantial losses to many growers. For many years, two sprays of lead arsenate (3 pounds per 100 gallons of water) gave good control. But, in 1955 damaging infestations were reported, and with the exception of 1959 this pest has since become more and more widespread. Initially, the lack of control, here as elsewhere, was attributed to the lack of applications, insufficient amounts of insecticide, poor coverage, or the improper timing of the sprays. Although in some instances these factors were responsible for poor control, our tests have since shown that two sprays of lead arsenate are not effective. Experience in Nova Scotia has been similar. More effective methods of control of the apple maggot are being sought.

At the Fredericton Research Station, we are attempting to improve control of the maggot by using poison bait sprays. In Florida, aerial spraying of poison bait sprays has successfully controlled the Mediterranean fruit moth. Since the apple maggot belonged to the same family, we decided to conduct tests using a poisoned bait spray containing malathion and a protein hydrolysate which, elsewhere, had successfully controlled fruit flies.

The success of these poison bait sprays is attributed to the baits, products of hydrolyzed proteins, which added to poison sprays, induce the flies to feed more readily and thus obtain a lethal dose of poison more rapidly. Bait sprays, when used as recommended, are not injurious to fruit or foliage, leave no harmful residues, and require less insecticide than ordinary sprays.

Several hydrolyzed proteins are effective lures for fruit flies, and those most recommended in bait sprays are enzymatic hydrolysates of yeast or acid hydrolysates of corn protein. The best results have been obtained when these lures were added to malathion or parathion sprays. But, malathion in wettable powder form is the only insecticide recommended for use in protein hydrolysate bait sprays. The recommendation for conventional power spray mixtures is one pound of hydrolysate to three pounds of malathion 25 w.p. in 20 to 100 gallons of water. Bait sprays are more effective when applied in concentrated form. Usually they are applied every two weeks, but during rainy weather it is necessary to apply them more often. Fungicides are not recommended for inclusion in bait sprays as they reduce the amount of attraction.

In our studies at Fredericton in an infested orchard, we have extensively tested several protein hydrolysates for their attractiveness to adults of the apple maggot. We found that traps baited with solutions of enzymatic hydrolysates of soy, yeast, casein, lactalbumin and acid hydrolysates of corn protein (Staley's Insecticide Baits Nos. 2 and 7) captured more

Concluded on page 13

The author is a fruit insect specialist at the CDA Research Station, Fredericton, N.B.

Plates (above and immediately below) illustrate high pre-fumigation total bacterial and mold counts.

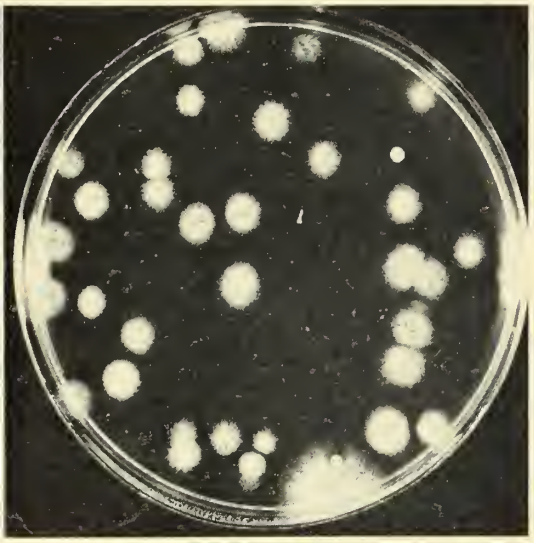
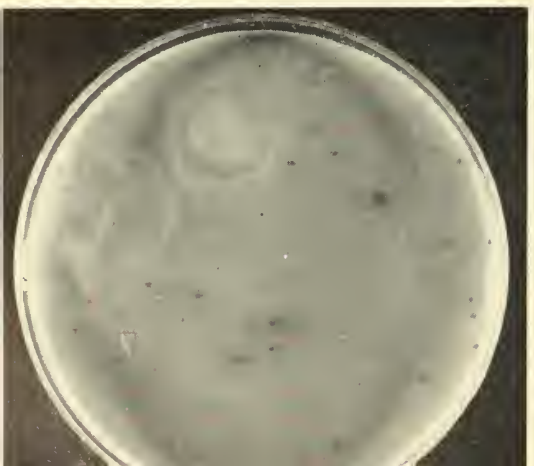


Plate below illustrates a moderate coliform count.



Microbial

Poultry H

S. E

New Test Evaluate and Sanitary Measu

POULTRY HATCHERIES bring forth the greatest number of "live births" of any branch of the animal industry, but in the process they may encounter problems with diseases that can be spread in their hatching machines. An egg harboring a specific bacterial infection such as pullorum or paratyphoid disease may, because of the simultaneous exposure of hundreds or thousands of susceptible birds, quickly infect the entire hatch. Aspergillosis, a mold infection, is another frequent source of severe losses in poults and chicks, as is omphalitis or navel-ill caused by exposure to large numbers of bacteria which in smaller numbers may be non-pathogenic. When these infectious agents get into the machine they persist unless sanitation measures are adequate.

As an aid in the control of these infections, most hatchery operators routinely fumigate their hatchers and setters, formaldehyde gas being the most commonly used agent. The variations in the quantities of formalin that have been recommended for this purpose by various workers and incubator manufacturers have prompted investigations of the amount required for effective fumigation. These studies have shown that some of the procedures recommended would not kill the micro-organisms causing the above diseases. Because many factors such as temperature, humidity and air-tightness of the machine influence the efficacy of fumigation, a need was evident for a test by which the results of the fumigation and sanitary measures could be evaluated.

Dr. Magwood is Head, Poultry Pathology Unit, Animal Pathology Laboratories, Health of Animals Division, Animal Diseases Research Institute, Hull, Que.

Author gathering fluff sample at ti
Inset: Close-up of fluff on incubator drawer
from suspensions of fluff in flasks shown.

hatch for laboratory examination. *Upper Lower Inset:* Culture plates being inoculated

xamination

tcher Fluff

rgwood

sults of Fumigation in Poultry Hatcheries

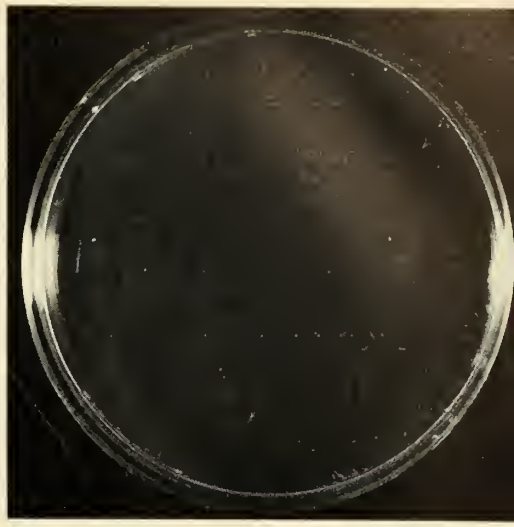
How Problem Was Approached

The problem has been approached from several angles. The method developed by Professor Wright of the Ontario Agricultural College has been extensively used in Ontario and has created considerable interest in other parts of Canada. For the test, two samples of dry fluff (composed largely of downy spicules shed by the newly-hatched bird) are collected as aseptically as possible from the hatcher, one at the time the hatch is taken off and the other after fumigation of the refuse remaining in the hatcher. The laboratory procedures involve separate microbial examinations of the pre- and post-fumigation samples in which counts are made in three categories of organisms; total aerobic bacteria, coliforms and molds. The counts are expressed as colonies per gram of fluff. The test is not a search for specific disease-producing organisms, but is a presumptive test in which the pre- and post-fumigation counts in the microbial categories serve as indicators of the efficacy of fumigation. For example, if the coliforms have been killed by exposure to formaldehyde then the process would also have been lethal for Salmonella that might be present.

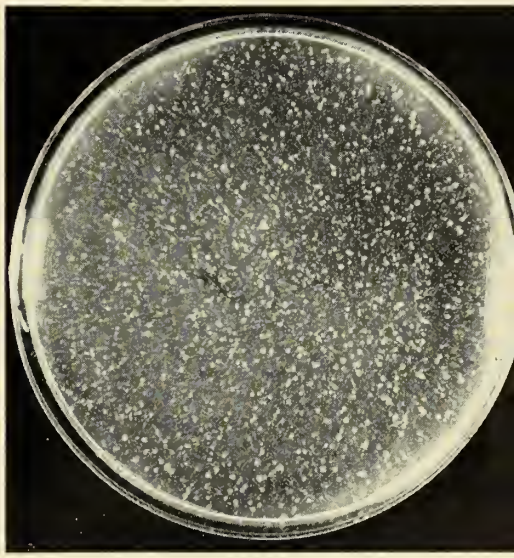
The variations in counts calculated from replicate examinations of a specimen have led some workers to question the reliability of the test. The interest of the Department in the application of the test prompted an investigation of the relative accuracy of the technique. For this purpose series of samples from various commercial hatcheries have been examined at the Animal Diseases Research Institute.

Investigations Revealing

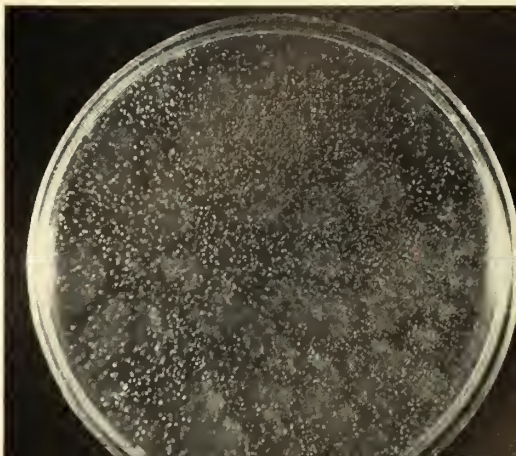
In one part of the investigation, 236 samples from 40 hatcheries were examined in duplicate. The



Above plate shows that when fumigation is effective the post-fumigation plates reveal little or no growth.



Plates immediately above and below illustrate result of an ineffective fumigation. The post-fumigation count (below) has been reduced somewhat from the extremely high count in the pre-fumigation sample (above) but is still unacceptably high.



RATINGS BASED ON MICROBIAL COUNTS OF FLUFF SAMPLES FROM FOUR HATCHERIES

Identification of Hatchery	Total Bacteria[1]				Coliforms[1]				Mold[2]				Overall Rating
	Before		After		Before		After		Before		After		
	Count	Rating	Count	Rating	Count	Rating	Count	Rating	Count	Rating	Count	Rating	
1	150	B	25	A	25	A	0	A	0	A	0	A	A=Excellent
2	300	C	25	A	50	B	0	A	4	B	0	A	B=Good
3	400	D	25	A	200	D	0	A	0	A	0	A	D=Unsatisfactory
4	2000	D	300	D	300	D	50	D	16	C	12	D	D=Unsatisfactory

[1] Bacterial counts in thousands per gram of fluff before and after fumigation.
[2] Mold counts in hundreds per gram of fluff before and after fumigation.

differences between these duplicate counts in each of the categories were pooled to provide estimates of variance from which were calculated 95% confidence limits for the counts in the six categories, (total bacteria, coliforms and molds, both before and after fumigation) as determined from any one sample. These limits confirmed that the test was soundly based and that the calculated counts could be used to designate "ratings" in all of the microbial categories. The results of a second study indicated that the usual delays between the collection and culturing of samples did not influence the counts significantly.

It was observed that the counts were generally low at the beginning of the hatching season, but in those hatcheries lacking effective sanitation programs, the microbial population built up quickly through successive hatches. Therefore, while too much significance should not be attached to the result of one test, a series reveals the sanitary status satisfactorily.

It was noted that some hatcheries regularly had low counts; in many the counts were consistently high, while in others they lay between these extremes. It was apparent that the ability to maintain low total bacterial counts ensured low coliform counts because those hatchers classed as "A" or "B" for total bacteria all fell in the "A" rating for coliforms before fumigation. The unsatisfactory group of samples, which were rated "D" for total bacteria after fumigation, included all those that were "D" for coliforms after fumigation. A fumigation that eliminated the coliforms almost invariably reduced the total bacterial counts to a satisfactory level. In brief therefore, effective fumigation killed both types of organisms but a concentration that was not lethal for coliforms also failed to reduce the total bacterial count.

High mold counts, when present, were usually associated with high bacterial and coliform counts. Only rarely were high mold counts associated with low total bacterial counts, suggesting that some place suitable for mold sporulation was present in what were otherwise clean surroundings. Generally, a fumigation that was effective against coliforms and other bacteria also killed mold spores, although in a very few instances the molds appeared to be more resistant to the action of formaldehyde.

When fumigation was shown to be ineffective, as indicated by the persistence of high counts after exposure to formaldehyde, it was found in some cases that the recommended procedure had not been followed. In one hatchery the formalin had polymerized to such an extent that the characteristic pungent smell was scarcely detectable.

Heavy bacterial populations did not appear to be a deterrent to effective fumigation since counts in the millions were frequently reduced by fumigation to zero or near zero. One of the features in the unsatisfactory group was a recurring pattern of extremely high pre-fumigation with low post-fumigation counts. The bacteria in these cases were typical of enteric organisms, being composed of Micrococci, Bacillus spp. and coliforms, suggesting that the hatchers were being contaminated by air-borne dust particles originating from faeces in chick

Panel of incubators in poultry hatchery.

brooders housed in the same building. It was intriguing to find in one hatchery that a particular hatcher qualified for an "A" or excellent rating at almost every test while another unit had unsatisfactory counts just as regularly; investigation revealed that the room which housed the former had an exhaust fan but the latter did not.

Rating Patterns

Four of the most frequently observed rating patterns are illustrated in the accompanying Table, with the microbial counts which designate the ratings in the individual categories and the final rating given the sample. The inconsistent ratings in the various categories for a single sample illustrate the need for determining the counts on the three types of micro-organisms. The "excellent" and "good" ratings given hatcheries 1 and 2 are understandable. An ineffective fumigation result was obtained in hatchery 4 as demonstrated by the high post-fumigation counts. However hatcheryman 3 on receiving an overall "D" rating for a sample entitled to four "A" ratings in the individual categories would likely raise some questions. The reason for this "unsatisfactory" designation is that the pre-fumigation total bacterial and coliform counts are high, and these counts represent the flora in the hatching environment. While the fumigation method was effective in reducing the counts after fumigation to satisfactory levels, nevertheless the chicks were exposed to the heavy pre-fumigation microbial population. If the numbers or kinds of organisms were suitable, infection might result.

Application of Test Results

How may the test results be applied in improving hatchery sanitation? How may they be used by the Poultry Production fieldman who is responsible for reporting on the sanitation in hatcheries in his district and advising on correct practices? It is his function to interpret laboratory reports to the hatcheryman. If unsatisfactory counts have been found and the source of trouble is immediately apparent he suggests corrective measures. If the cause is obscure he seeks it out. In these problem situations close scrutiny of the operation, discussion with fellow workers and effective liaison with the laboratory should disclose the cause, although this new approach has revealed many gaps in our knowledge. The test is also a useful tool now being employed in investigations of a number of procedures that might affect the sanitary status of hatchers. Exchange of information between field and laboratory workers and correlation of results will form a better background for the intelligent application of the test in the future.

Cucumber Pickles . . . *(from page 6)*

this type of pickle and preservation is achieved by a high sugar or vinegar concentration or both.

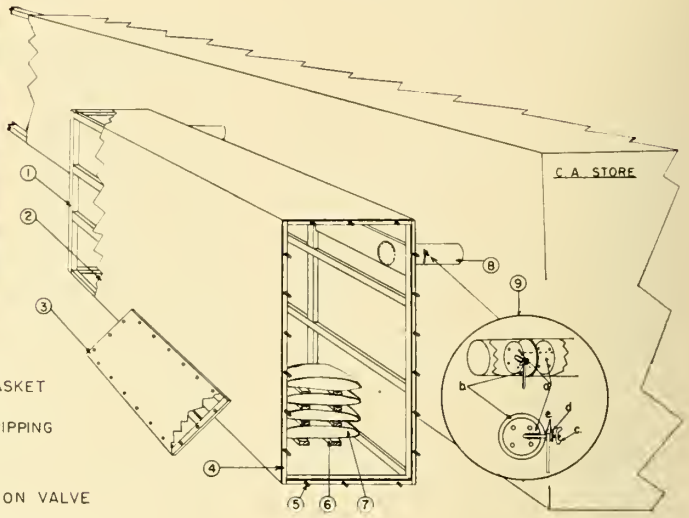
The fermentation method has the advantage of providing convenient storage for cucumbers until they are manufactured into pickles. It also has noteworthy disadvantages. There can be considerable product loss through shrinkage and spoilage during fermentation in salt brine. Softening is caused by action of pectolytic enzymes produced by bacteria and hollow pickles or bloaters result from a gaseous fermentation. These are constant problems that have resulted in considerable research. In recent investigations, a fruit pressure tester has been used to determine the firmness of fermented cucumbers thus providing an objective method of measuring the quality.

A more recent method of pickle manufacture is the pasteurization process whereby fresh cucumbers are made directly into pickles. Preliminary laboratory research on pickle pasteurization was performed in 1938 and since that time the method has been investigated further and used increasingly by industry. It has offered an alternative to fermentation for certain types of pickles and the process is not subject to the spoilage problems associated with the salting procedure. In this method, fresh cucumbers are packed into containers and covered with spiced vinegar which may contain sugar. The contents are pasteurized at temperatures sufficient to heat the product at the centre of the containers to 165 deg. F. for fifteen minutes, followed by prompt cooling. In the manufacture of fresh-pack sweet pickles the use of thin slices and relatively low sugar-vinegar concentrations minimizes the shrinkage of the product during pasteurization.

In our tests we have found that the vacuum method of pickle-making has distinct potential advantages over the conventional procedures when preparing sweet sliced cucumber pickles. In essence, the method consists of subjecting fresh cucumber slices to a high vacuum, thereby removing the entrapped gases that are then replaced with water. Vacuum-treated slices resist shrivelling when pasteurized in sweet pickling vinegar. Fresh cucumber slices are placed in a chamber and subjected to a vacuum equivalent to at least 26 inches of mercury. After two minutes water is added and the vacuum is released. The treated slices are convex because of excess absorption of water. If thick slices are used, a blanch for three minutes at 160 deg. F. improves the pliability for easier packing. The sliced cucumbers are then packed into containers, sweet spiced vinegar is added and pasteurization is carried out by the usual commercial procedure. In laboratory tests, using concentrated sweet pickling vinegar, we obtained substantial increases in product yield of up to ten per cent of the fresh weight from vacuum-treated slices. This was in contrast to considerable shrinkage in the untreated control samples pasteurized in the same manner.

The vacuum method appears to have good commercial possibilities. Very desirable pickles with excellent translucence, crispness, and yield result from this process. This method makes it feasible to pack thick cucumber slices, such as those found in sweet mixed pickles, directly from fresh cucumbers without shrivelling, thus eliminating the lengthy fermentation. In addition, tests at Morden have shown that the quality and yield of freshpack sliced cucumber pickles can be improved by adding a vacuum treatment to the regular pasteurization process.

Diagrammatic drawing (below) of semi-automatic scrubber for controlled atmosphere (C.A.) apple storages; actual installation (left).



1. WOODEN FRAME
2. METAL COVERING
3. DOOR
4. SPONGE RUBBER GASKET
5. THREADED BOLTS
6. 2"x4" WOODEN STRIPPING
7. HYD. LIME
8. 4" PIPE
9. DETAIL OF DIFFUSION VALVE
   - a METAL DISC
   - b SPONGE RUBBER
   - c LOCK NUT
   - d METAL WASHER
   - e SPONGE RUBBER WASHER

SEMI-AUTOMATIC SCRUBBER FOR CONTROLLED ATMOSPHERE APPLE STORAGES

Semi-Automatic Dry Scrubber For C. A. Apple Storages

C. A. Eaves

STORAGE of apples in controlled atmospheres is now commercially important in Canada and elsewhere. Frequently, the operation of a C.A. storage involves the use of a scrubbing device to remove the excess carbon dioxide gas (CO_2) produced by the fruit. A solution of caustic soda, a material both dangerous and costly, has been used as the CO_2 absorbent in scrubbers until recently when we discovered at Kentville that CO_2 could be effectively absorbed by hydrated lime commonly used for orchard spray purposes.

We conducted experiments with open bags of this material and made gas permeability tests with different thicknesses of kraft paper. From these studies, we concluded that an unopened 50 lb. bag of fresh hydrated lime when placed in an atmosphere containing CO_2 is capable of absorbing 20-25 lb. of the gas.

Briefly then, this new method of CO_2 absorption is based on the controlled diffusion of the storage atmosphere over unopened bags of lime placed in a separate gas tight container.

After successfully storing McIntosh apples in two 800-box plastic units with the aid of the dry scrubber, we decided to try the method in a commercial storage with a capacity of 6000 boxes.

To do this, a new and larger scrubbing device had to be developed. Initial tests showed that approximately one pound of lime was required for each bushel stored over a period of six months. Accordingly the scrubber was built to accommodate 6000 lb. of lime or 120-50 lb. bags. This was placed in a galvanized iron box 20′ x 7′ x 3′ equipped at one end with a removable panel fitted with a rubber gasket (see above sketch). It should be noted that half of this amount can be used initially and a second charge of lime inserted after 3 months. When loading the scrubber we separated the layers of bags by 2′ x 4′ wooden strips to aid air circulation.

Four galvanized iron diffusion pipes 4 inches in diameter and 18 inches long, equipped with butterfly valves, were inserted into the scrubber 2 feet from each corner and connected to the interior of the store. A 2-inch lip was provided at the ends of the pipe to allow for the application of a good seal of caulking compound to prevent leakage. The valves were made tight by rivetting a strip of sponge rubber to the circular edge so that a quarter inch of rubber extended beyond the metal edge. A valve lock of small bolts was added to prevent accidental opening of the valve. A small conoidal fan was inserted in one of the pipes but was not operated since the carbon dioxide absorption was satisfactory with the two upper pipes only.

After the store was loaded and sealed, the valves were kept closed until the carbon dioxide had

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reached a level of 3 per cent. The two upper valves were then fully opened and thereafter adjusted to provide the correct rate of diffusion. Apart from the single daily gas analysis and the occasional valve adjustment, the store required no attention (see graph).

A plastic scrubber holding twenty 50 lb. bags of lime was also successfully operated in conjunction with a 1000-box store of McIntosh apples.

Capital costs of this method in relation to caustic soda or water scrubbers are much reduced. For example, a quotation of $500.00 was received for a caustic soda scrubber to be used with the 6000-box store whereas the dry scrubber was built at the plant for $150.00. The cost of the plastic scrubber was only $20.00.

The following table shows that the cost for materials and operation of the dry scrubber is approximately one-fifth of that required for caustic soda scrubbing.

Comparative costs of caustic soda and dry lime scrubbing (based on 5000 bushels for 200 days)

	Quantity (lb.)	Cost of materials ($)	Cost of daily operation (cts.)	Total cost per bushel
Caustic Soda	3300	230.50	6.4	.10*
Lime N.S.	6000	105.00	..	.02

*This figure agrees with the findings of other workers in North America.

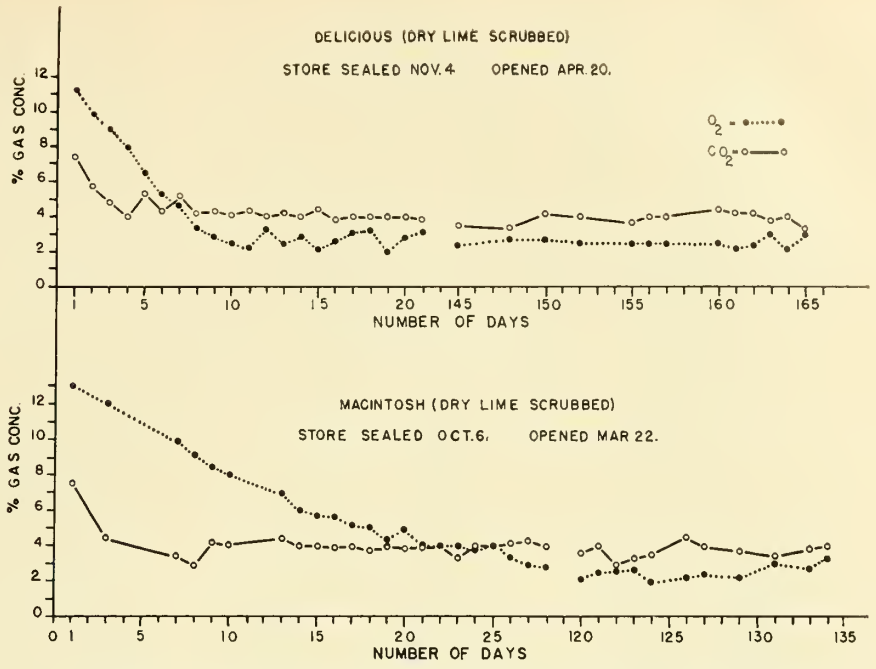
The dry lime scrubber eliminates the following undesirable features of caustic soda scrubbing: (1) Daily mixing and charging; (2) Risk to personnel; (3) Risk of power failure*; (4) Corrosion of parts; (5) Depreciation of machinery; (6) Disposal problems; and (7) Daily fluctuation of CO_2 conc.*

The water scrubbing equipment described by Smock[1] appears to be similar to that used for caustic and whilst operating costs are reduced with water, there are problems associated with adequate carbon dioxide absorption in the early part of the storage period as well as the need for extreme gas tightness. The supplementary use of the dry scrubber in plants now equipped with water scrubbers offers possibilities.

Consistently high relative humidities ranging between 90-92 per cent have been recorded in dry scrubbed stores, consequently, weight losses have been negligible. With reference to the all-important subject of quality the plant manager of a local Co-operative states, "The McIntosh apples were examined for flavor, moisture loss, scald, etc., at the time of packing. We were satisfield that they had kept as well as when scrubbed with caustic solution." In view of similar reports from plant operators in England who have adopted this method, it would appear that apple growers may achieve substantial economies by the adoption of this technique.

*These items also apply to the water scrubbing method.

[1]Proc. American Soc. Hort. Sci. 75:53-60. 1961.



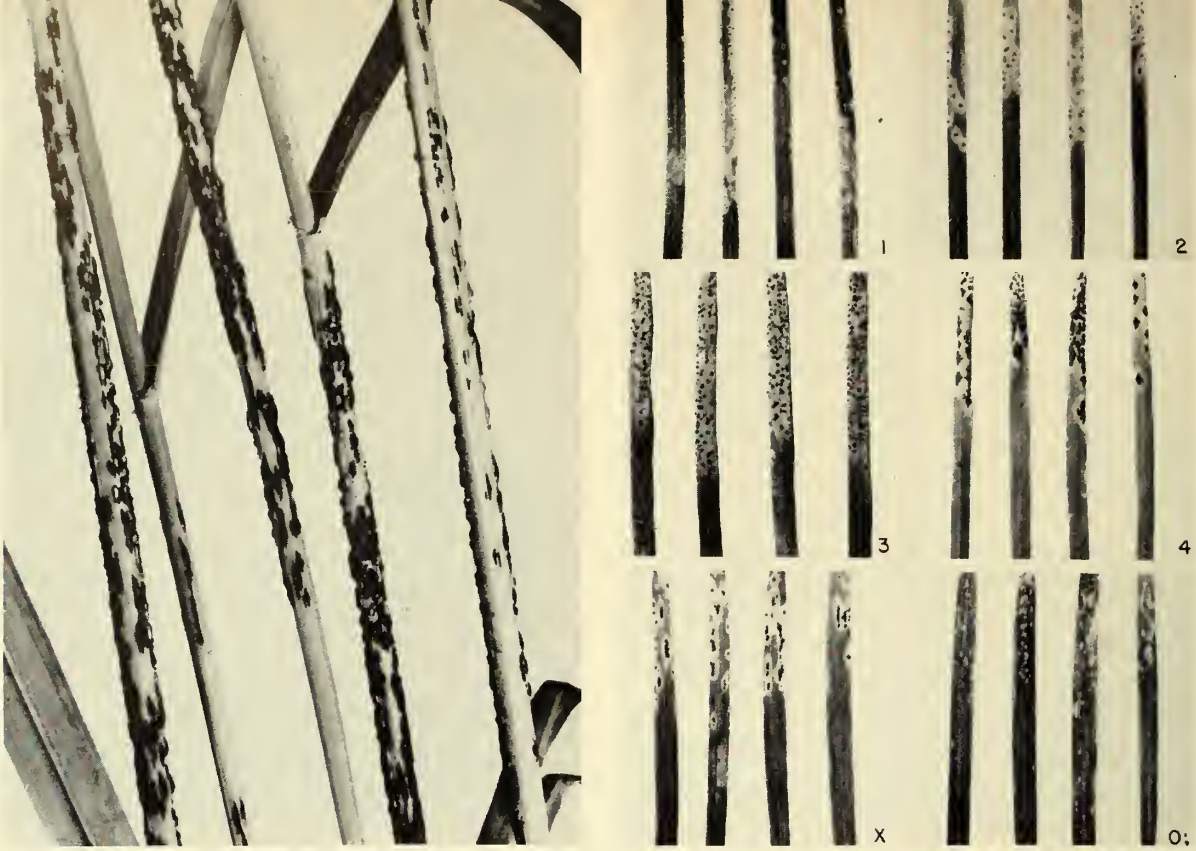
Changes in oxygen and carbon dioxide content during storage period. Once store is loaded and sealed, and carbon dioxide (CO_2) reaches 3% level, valves are adjusted to provide correct rate of diffusion.

Apple Maggot Control . . . *(from page 7)*

adults than those of a recommended lure of urea-sodium hydroxide. Our investigations revealed that enzymatic soy and casein hydrolysate were the best lures, trapping a substantially greater number of flies during the four-year testing period than the other hydrolysates. There was no appreciable difference in the attractiveness of the two acid hydrolysates and enzymatic yeast and lactalbumin hydrolysates.

The establishment of protein hydrolysates as better lures for apple maggot is encouraging, although at present their value in poison sprays for the control of this pest has not been fully determined. In preliminary tests we found that the addition of soy hydrolysate, the best lure, and Staley's Insecticide Bait No. 7, a commercial lure, to lead arsenate sprays did not improve control. However, the results were not surprising as other workers have obtained poor control when these lures were added to insecticidal sprays other than fast killing organic phosphates.

At the Fredericton Research Station, we are continuing to test poison bait sprays for apple maggot control and hope to find a suitable combination of bait and insecticide. Under the present circumstances in New Brunswick, the recommendations for control will undoubtedly be changed, and possibly organic phosphates will replace the arsenicals. These insecticides are more expensive than arsenicals, but if the addition of protein lures will give better control with less insecticide, the increase in cost would not be as great.



Stem rust of wheat (left) is perhaps North America's most important plant disease. Some 'infection types' (right) of wheat stem rust. Each race of rust has its characteristic infection types on any given wheat variety. These are some of the characters of stem rust that can be subjected to genetical study.

Getting To Know Genes Better

Genetics of Pathogenic Organisms in Relation to the Development of Resistant Varieties

C. O. Person

FOR MANY of the diseases that devastate our crops the best defence lies in the production of resistant varieties. The increase in production that follows the introduction of a new variety can be roughly estimated, and for a rust-resistant cereal variety it would amount to millions of dollars. No one can doubt the importance of this kind of research. There are other related areas of research, however, whose value to society is not so easily assessed. For example, it is now generally accepted that the introduction of a new and resistant variety confers only a temporary benefit; that a new and virulent pathogen will appear. It therefore becomes a problem of practical importance to investigate the mechanisms by which new pathogens do arise, and the devices by which they become so specific in their pathogenicity, for information on these mechanisms could conceivably place the investigator in a position to anticipate some of the characteristics of the future pathogen, and to predict in rough terms the conditions under which it will arise. But although such information would obviously be of great value, it would be difficult if not impossible to estimate its value in dollars, for new information, unlike wheat, is not sold on the world market.

A second factor to be considered is that with research in these areas there can be no assurance at the outset that the information to be obtained will be of ultimate practical benefit. A guarantee on this point would presume a foreknowledge of the results. Most investigators must simply take it as an article of faith that new information is in itself of lasting value, and that it may ultimately prove useful in approaching practical problems. They can refer to the works of Darwin on Evolution and of Mendel on Heredity a century ago, neither of which at the time seemed to point to any obvious benefit, but which today form the basis of, and find their application in, the production of new and resistant varieties for the control of disease.

Ever since its inception 35 years ago it has been a practice at the Winnipeg laboratory not to overlook the wider aspects of the disease problem. Then, as now, the rusts were a major threat to cereal production. At that time it was known that there were many different wheat-rust races, and that each race in its infections on certain test varieties produced its own specific pattern of disease

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Clustercup stage af stem rust an barberry. The cups, each a tube filled with spares, culminate the sexual phase af the rust. As many af them ariginate fram crosses between rust races, they are a fertile saurce af new rust strains.

reactions, distinct from those produced by other races. The reasons for these differences in reaction patterns were completely obscure; it was not known, for example, whether or not the differences between races were determined by genes. Moreover, it was not possible to look for genetic differences because certain information on the life-history of the rusts, necessary for this kind of study, was lacking. One of the early discoveries at this laboratory supplied this needed information, and cleared the way for further progress. It was now possible, for the first time, to study the means by which pathogenic specificity in the rusts was inherited.

Genetic Studies Initiated

Genetic studies were immediately initiated at the Winnipeg laboratory; and other countries soon had scientists also working in this experimental area. These studies showed that the specificity of rust races toward the test varieties was determined by Mendelian genes. In certain cases the specificity toward a single variety could be related to a single gene. Leaving the details aside, it can be said that one of the great achievements of this work was that it brought together two different concepts that had previously been quite unrelated. On the one hand there had been the physiologic race, the unit of pathology; on the other there had been the gene, the segregating unit of genetics. This work showed that a physiologic race could include a variety of different genes, and that it was really the genes that provided the basis for pathogenicity. The physiologic race merely collected the different genetic types into arbitrary categories, according to which varieties had been chosen as tester stocks. This concept is now held to be valid for most if not all systems of parasitism in which physiologic races are recognized.

These studies, and related work in other countries, had the effect of directing attention to the gene. It became clear that the important event leading to new virulence in the pathogen—to a new race—was the acquisition by the rust of a new and virulent gene. It had long been known that the resistance of varieties to the rusts was also determined by genes. In the production of resistant varieties, specific genes for resistance were often transferred to the new variety from other varieties that were otherwise quite unsuitable for production. Specific genes for virulence in the rusts were thus kept under control by introducing specific genes for resistance into a host variety. The hypothesis was brought forward, by an American researcher, that the reaction between virulence in the pathogen and resistance in the hosts was really the interplay between specific and related genes. According to this gene-for-gene hypothesis, as it has come to be called, each gene in the host has its interacting counterpart in the parasite, with the result that the genetic systems of the host and parasite are functionally interlocked.

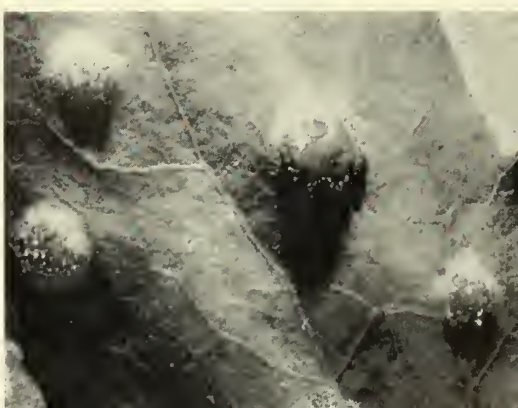
The gene-for-gene hypothesis was not immediately accepted by the scientific community; observational data to support it were difficult to obtain. Yet if the hypothesis could be shown to be valid, it would form the basis for a much more refined approach to the work, both theoretical and practical. In recent studies, again at Winnipeg, an attempt has been made to validate the gene-for-gene hypothesis, and this has also led to the enunciation of new methods of analysis for parasitic systems. Whether the results of this study will stand the tests of time remains to be seen.

Genetics af Parasitism

Let us now look to see if the studies on the genetics of parasitism have had any effect on the more immediate problem of producing resistant varieties. We have said that one of the main results of the earlier work has been to focus attention away from the physiologic race and toward the gene. A number of laboratories are at the present time engaged in the production of "single-gene" lines. These are, generally speaking, lines that are established in a variety having good agronomic characteristics, each differing from the original variety in the possession of a single resistance gene. Such lines are likely to be far more efficient in analysing the pathogenic properties of the pathogen, and should ultimately reduce the time it normally takes to synthesize a good variety with new resistance. At certain laboratories, including Winnipeg, the further refinement of locating the resistance gene to the chromosome which carries it, is also being carried out. This kind of work, taken together with other information that is steadily accumulating, is certain to place the researcher in a much stronger position to meet the immediate practical problem of producing a resistant variety.

As was stated earlier, it is difficult to assess the value of scientific work whose primary objective is to search for new information; there is no way of predicting beforehand exactly which piece of new information is to be needed. At the same time there is the practical problem of maintaining cereal production and, as experience has shown, this can on occasion be urgent. It is clear that research in the various related fields must be kept in proper balance; our successes in meeting challenges in both the practical and its related fields can be taken as a measure of the administrative success in maintaining this necessary balance.

Pycnia af wheat stem rust an common barberry. Pycnia af the rusts have a sexual functian and so can be used as a means af crassing rust races.



More Instant Food Lines in the Making

The Spring '61 issue of *Research for Farmers* carried a short feature on the instant potato process developed by Dr. E. A. M. Asselbergs of the Department's Plant Research Institute at Ottawa. In the meantime, he has adapted the invention to meat, fish, cheese, turnip and pumpkin. In his work to date he has chosen foods with a minimum oil content.

The new products are similarly made, the moisture being removed by steam-heated drums, and similarly reconstituted, by adding milk or water. The food processing laboratory has now developed the following instant-cooked foods: mashed potatoes, fish-potato, beef-potato, pork-potato, lamb-potato, chicken-potato, cheese-potato, turnip and pumpkin.

These lightweight pre-cooked meals can be stockpiled for emergency use, or kept indefinitely in the kitchen cupboard. They can be converted into a hot meal in a few minutes or, if necessary, eaten dry without any other preparation. The new products are, therefore, expected to be of advantage to the ordinary consumer, to institutions and to countries interested in setting up food banks.

Process Details

Fish—The species used were the saltwater hake, cod and pollock and the freshwater whitefish.

Only fillets are used. These are cooked and comminuted—that is finely ground—in order to incorporate the pin bones into the puree which is passed through a mesh, mixed with mashed potatoes and dried in 20 seconds. The pin bones cannot be removed from the fillet by practical means but their presence in comminuted form adds to the calcium content of the mix.

Meats—The beef cuts, minus bones, are ground up, mixed with mashed potatoes and passed between the steam-heated drums for simultaneous cooking and drying. The same system is applied to lamb and pork meats. Chicken is cooked sufficiently to enable the bones to be extracted and the meat is then ground, mixed and drum dried. The instant potato and meat mixes make excellent croquets and casserole dishes.

Cheese—Medium cheddar cheese is ground and then mixed one part to three parts of mashed potatoes, for drum drying. The drying removes the moisture content, generally 30 per cent, from the cheese. The dry mix rehydrates instantly in cold or hot milk or water and has a nice creamy texture. It makes an excellent cheese casserole or sauce.

Turnip—The Laurentian variety grown in Ontario and New Brunswick was found quite suitable for processing. Turnips are peeled, sliced, cooked, pureed and put through a mesh before drum drying.

Pumpkin—Pumpkins are similarly treated but because of the high water content require longer to process.

Cheap to Make

The costs of manufacturing the new foods was low and the same equipment, the steam heated drum drier, was used throughout.

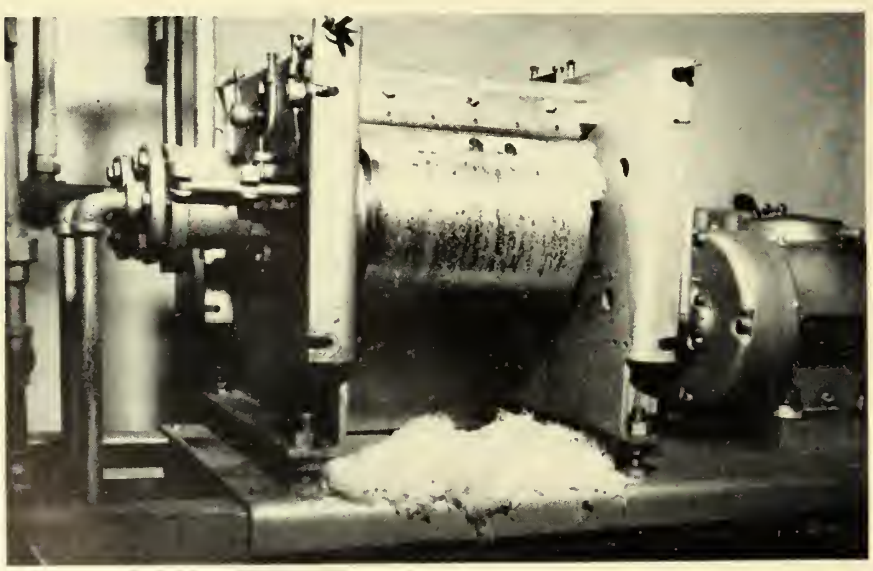
Variations in reconstitution of the food are possible, the Asselbergs product being the basic precooked dehydrated food ready for instant use.

Licences[1] for manufacturing the new food products will be protected by the Public Servants Inventions Act. It is expected that licences will be sought as the products can be made with the same equipment now being built for the manufacture of potato crystals.

Dr. Asselbergs has seen many taste panels smack their lips in appreciation of the new food lines his unit has put out.

It has been established that there is virtually no loss of the nutritional value of the food in the processing—other than the normal loss through any form of cooking. But he says that it is up to the commercial food firms to evaluate the selling quality of the products and they will decide such matters as spicing, additives and packaging. He sees no reason, with the trend to "convenience foods", why the whole line of new products should not gain popular acceptance leading to construction of processing plants with their opportunities for employment and greater sale of farm products.

[1]Licences for the manufacture of the first discovery—now known as potato crystals—have been taken out by several leading food processors in Canada and abroad.



Instant mashed potato process has now been adapted to meat, fish, cheese, turnips, and pumpkin.